Introduction to Antenna Modeling

Building and Evaluating Antennas without:

Wires
Tangles
Insulators
Aluminum Tubing
Towers
Ladders

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Comm Academy - April, 2010

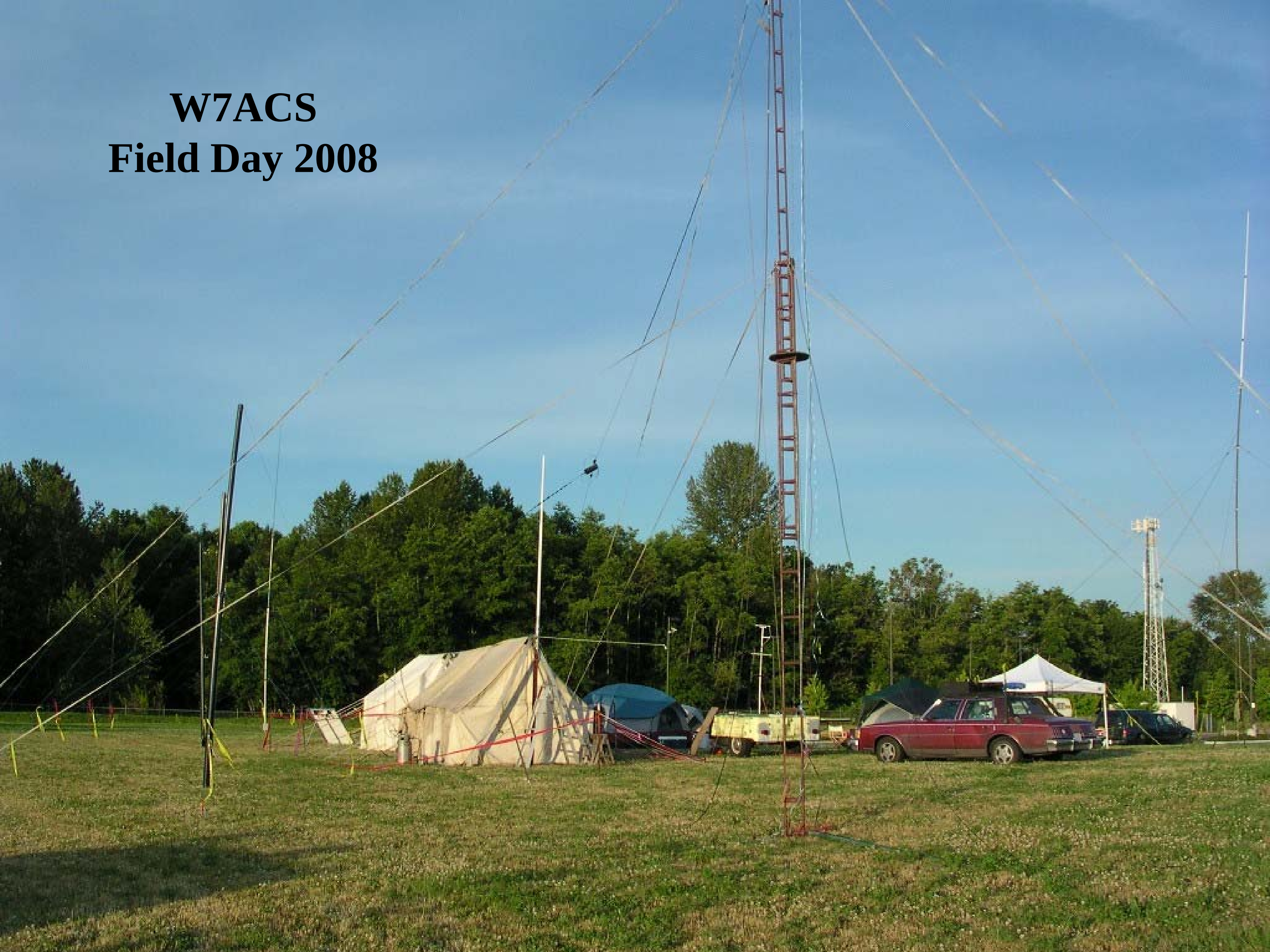
Why Antennas?

Every ham needs at least one antenna –

Simple antennas are easy to make –

The ultimate antenna will never be made –

W7ACS
Field Day 2008



Why Antenna Modeling?

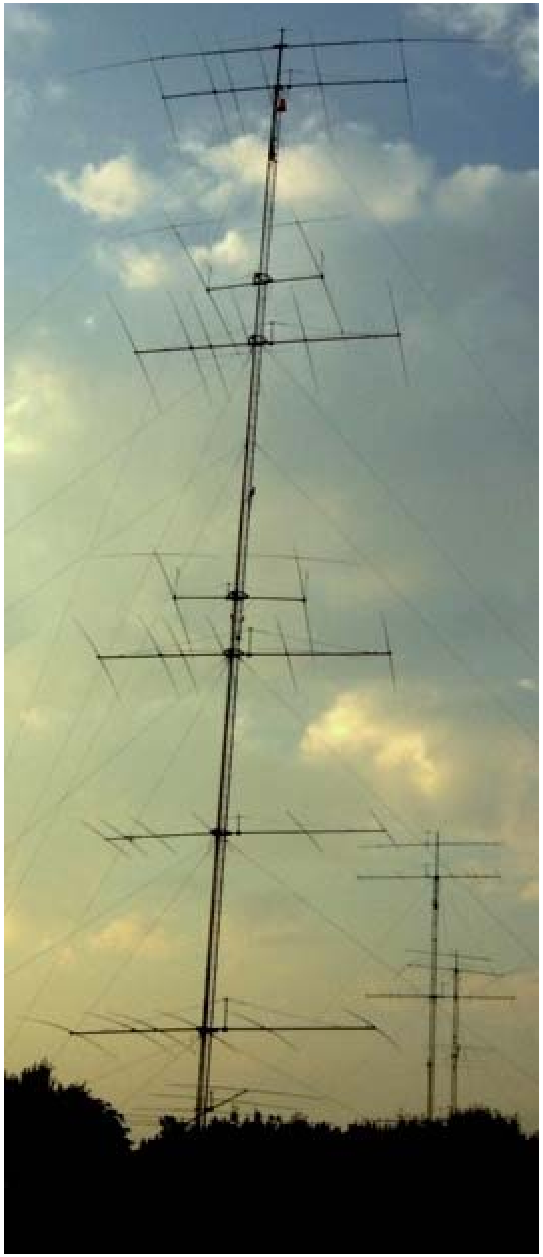
Saves time, effort, and materials –

Can evaluate antennas which are impossible to build –

Can compare many different antenna designs –

K3LR "New 20 Meter Tower"

(nine antennas with seven rotors)



M2/W6ANR/Tornado 80 meter dipole:
(240 ft.)

6/6/6/6 20 meter Optimized Wideband Antennas (WA3FET):
(230/170/110/50 ft.)

2/2 40 meter Moxon (W6NL):
(185/120 ft.)

6/6 15 meter M2: (80/40 ft.)

Antenna Design Concepts

Wavelength = 300,000,000/Frequency MHz

Radiation Pattern (Azimuth and Elevation)

Resonance and Impedance

Feedline, Matching and Antenna Tuners

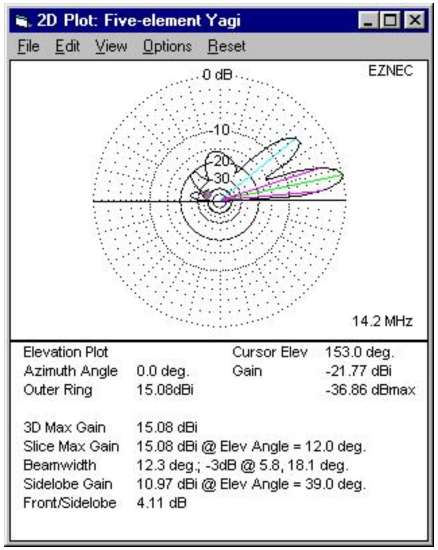
Standing Wave Ratio (SWR)

Antenna Modeling Programs

EZNEC by Roy Lewallen W7EL (www.eznec.com)

EZNEC-ARRL (included with ARRL Antenna Book)

ARRL Continuing Education (www.arrl.org/cce)



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Elevation Plot                     Cursor Elev    153.0 deg.
Azimuth Angle    0.0 deg.          Gain           -21.77 dBi
Outer Ring       15.08dBi                         -36.86 dBmax

3D Max Gain      15.08 dBi
Slice Max Gain   15.08 dBi @ Elev Angle = 12.0 deg.
Beamwidth        12.3 deg.; -3dB @ 5.8, 18.1 deg.
Sidelobe Gain    10.97 dBi @ Elev Angle = 39.0 deg.
Front/Sidelobe   4.11 dB
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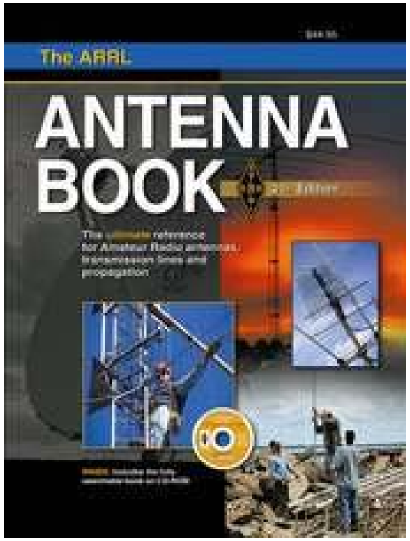


Antenna Modeling Concepts

X, Y, Z Space – 3 dimensional space around the antenna

Wire – individual wires making up an antenna

Wire Segment – sections of each wire evaluated by the program

Feedpoint – point of excitation of the antenna

Free Space vs. Real Ground

Example #1: 80/75 Meter Dipole

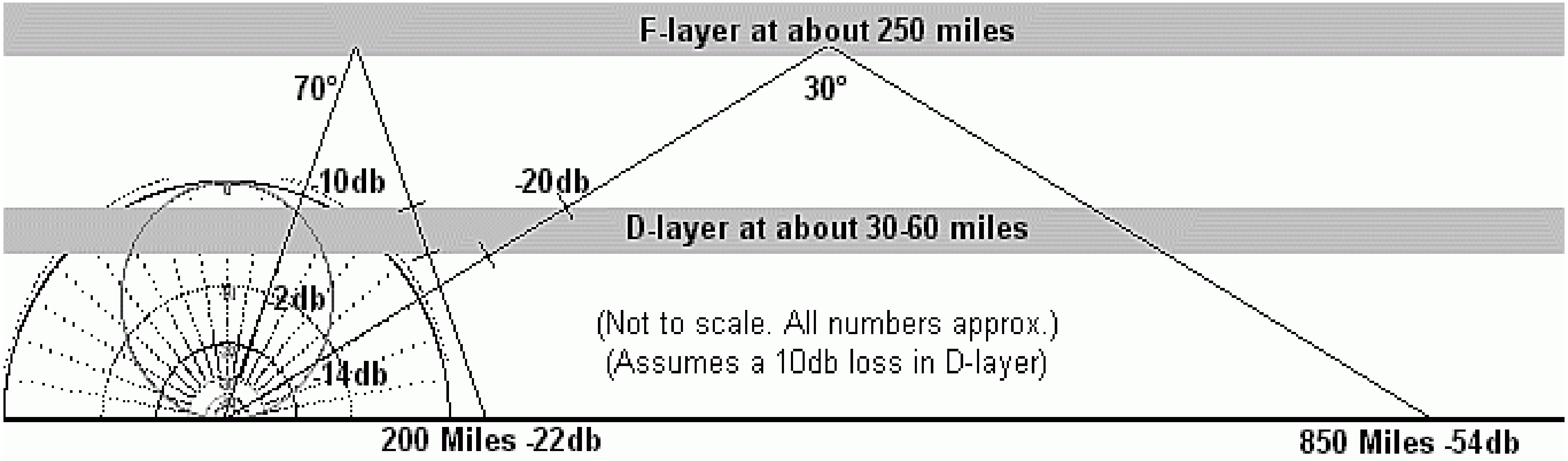
Horizontal half-wavelength Dipole

Design Frequency: 3.985 MHz (WA State Emergency Net)

Optimized for Near Vertical Incident Skywave (NVIS) Propagation

NVIS

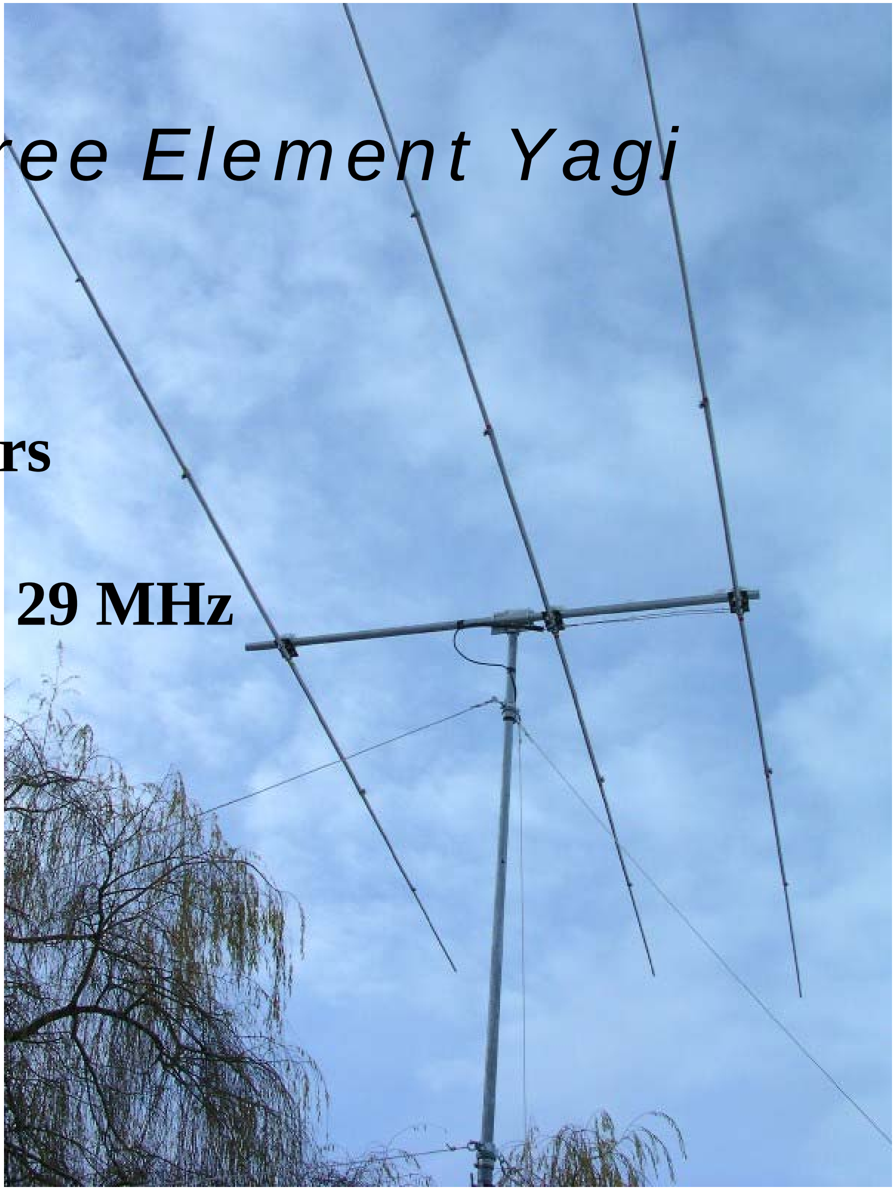
(Near Vertical Incident Skywave)


F-layer at about 250 miles
70°
30°
-10db
-20db
D-layer at about 30-60 miles
-2db
-14db
(Not to scale. All numbers approx.)
(Assumes a 10db loss in D-layer)
200 Miles -22db
850 Miles -54db

Propagation – "Critical Frequency"

High Angle Antenna – Approximately ¼ Wavelength Above the Ground

Example #2: Three Element Yagi

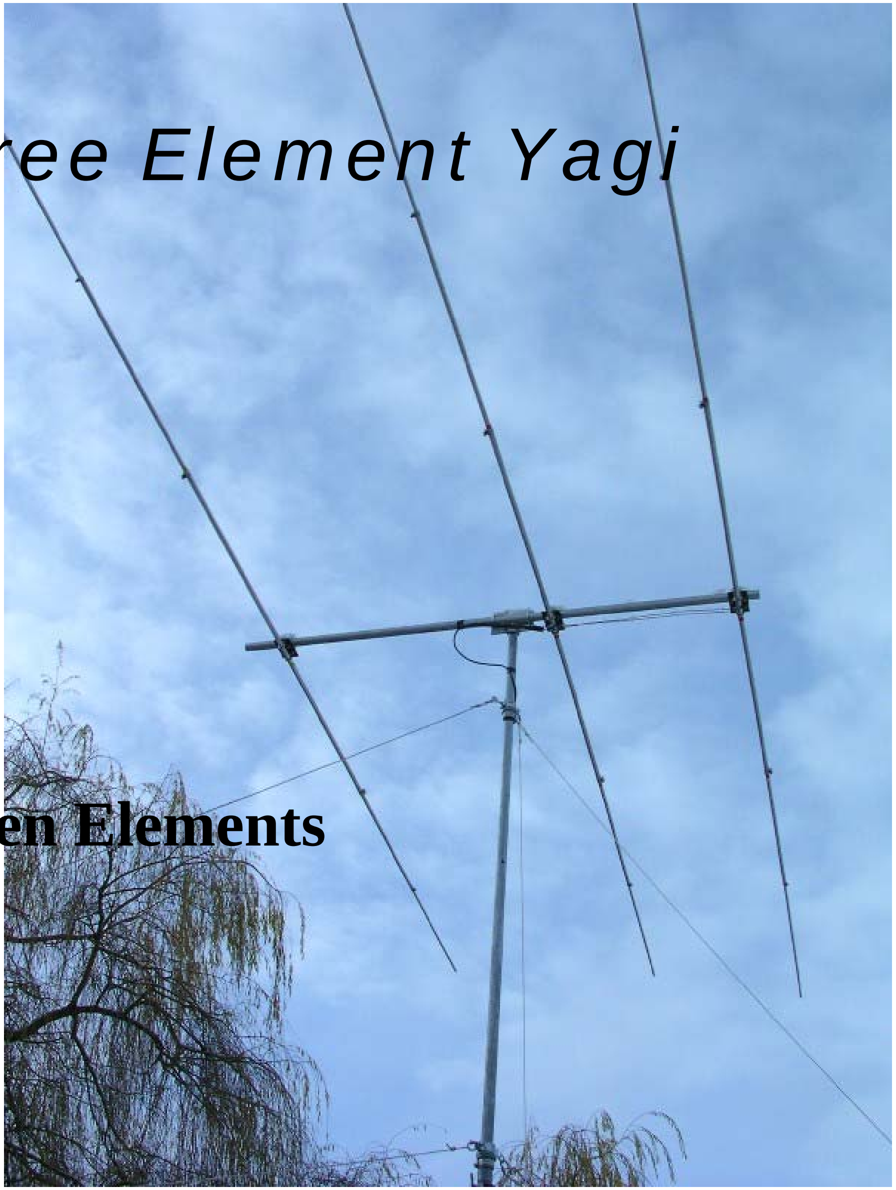


A Short Boom, Wideband,
Three Element Yagi for 10 Meters

Less than 1.5:1 SWR from 28 to 29 MHz
Direct 50 ohm Coax Feed
Shortest Feasible Boom Length
Simple Construction

From October, 2008, QST
by L. B. Cebik W4RNL (SK)

Example #2: Three Element Yagi



Modeling Issues:

Additional Elements
Telescoping Aluminum Tubing
Phase Line connecting Two Driven Elements

Example #3: 2 Meter Vertical

Quarter Wave Ground Plane

Half Wave Vertical

J-Pole

Conclusion

Modeling saves time, effort, and materials –

Can evaluate antennas which are impossible to build –

Can compare many different antenna designs –

Don’t forget to Get On The Air!

Thank you!